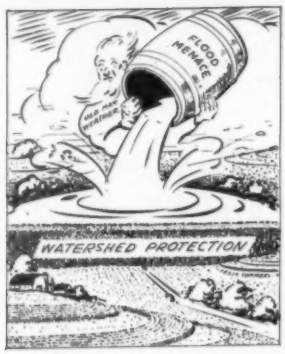
TECHNOLOGY & SCIENCE

APRIL 1963

# Soil Conservation

SOIL CONSERVATION SERVICE • U. S. DEPARTMENT OF AGRICULTURE




## Soil Conservation

## *25 Years Ago*

"It is evident that the 'stability' of a gully may be described more accurately as 'dormancy.' To prevent rejuvenation or the renewal of excessive cutting, the watershed of the gully must be protected. This may be accomplished by cultivation practices designed to prevent excessive runoff, by revegetation, or by building up the organic content of the soil. The valley below must also be protected in order to prevent the stream from lowering its present base level. An increase in the water supply in any part of the drainage system beyond its normal capacity is therefore a potential source of danger.

"Therefore . . . one may say that a gully is stable, not when the walls and head have ceased advancing, nor when the channel of the gully has ceased cutting downward and is filled with growing vegetation, but only when all precautions have been taken to prevent renewed cutting and the consequent introduction of a new cycle of erosion."

COVER PICTURE. — Floodwater dams like this one on the Ray Tucker farm in the Plum Creek watershed near Finchville, Ky., are being planned and built at an ever-faster rate in small watersheds across the country, providing, also, recreational, municipal, and industrial water supply, and other public and private benefits.

—Photo by E. W. Cole

VOL. XXVIII, NO. 9 APRIL 1963

## CONTENTS

PAGE

195 Watershed Lands and Water Are Everybody's Concern
*By Donald A. Williams*

198 Watershed Project Brings Community Rewards
*By Gordon S. Smith*

200 Ranch Watershed Job Pays Good Dividends
By Robert Dellberg

201 Watershed Conservation Insures City Water Supply
*By Willis J. Ridenour*

203 Utah Irrigators Lick Water Losses
*By Don L. Braithwaite*

204 Georgia Towns Reap Watershed Benefits
*By James S. White, Jr.*

206 Study Downstream Effects of Upstream Improvements
*By M. A. Hartman and W. O. Ree*

208 Irrigated Land Leveling Saves Water and Labor
*By Wayne D. Wavrin*

209 Waterfowl Marsh Developments Catch On
*By Edwin A. Swenson, Jr.*

211 Paper Mulch Helps Grass Grow on Dams
*By William L. Smith*

212 Snow Water
*By R. A. Work*

214 Irrigators' Management Key To Water Saving
*By Tyler H. Quackenbrush*

215 Bentonite Pond Lining Solves Water Problem
*By Jack Wiese*

216 Book Review

# Soil Conservation

ORVILLE L. FREEMAN
Secretary of Agriculture

DONALD A. WILLIAMS
Administrator, Soil Conservation Service

**SOIL CONSERVATION** is the official organ of the Soil Conservation Service, published by direction of the Secretary of Agriculture as administrative information required for proper transaction of the public business. The printing of this publication was approved by the Bureau of the Budget, June 26, 1958.

FRANK B. HARPER, Editor

15 CENTS PER COPY $1.50 PER YEAR

FOREIGN—$2.25 PER YEAR

25 percent discount on orders of 100 or more mailed to one address.

**All orders for paid subscriptions go to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.**

# Watershed Lands and Water Are Everybody's Concern

By Donald A. Williams

ALL those who share in the ownership or management of the Nation's land and water resources today must cope with tremendous new challenges. They have been brought about by our magnificent technological advances, rapidly expanding population, increasing urbanization, and shifting land use patterns—all of which combine to place new and competing demands on our remaining land and water resources, which are the very foundation of our economy and our standard of living.

Our land and water resources are vital national assets. How we conserve, develop, and manage these natural resources will affect our economic growth, the strength of our Nation, and our longrun status in world affairs. The basic resources of land and water serve all the people of the Nation. Land and water problems are of increasing concern to both farm and nonfarm people. Carefully planned programs to satisfy both rural and urban needs are essential.

The interrelationship between farm and nonfarm interests in resource conservation, although a truism from the beginning, has come to be recognized only in recent years. Today, more and more people realize that "city" conservation problems and "farm" conservation problems are not separate and distinct problems. They are so interrelated that one can scarcely tell where a rural conservation problem leaves off and an urban conservation problem begins.

We know, for example, that just about all of our water falls on the land, for less than 2 percent of the Nation's total area is in lakes or streams, and that three-fourths of this land on which all our rain and snow falls is in private ownership and 60 percent is in farms and ranches. Management, use, manipulation, and development of our water resource, therefore, begins largely on the privately owned lands.

This is the water that grows our crops, provides forage for our livestock. This is the water that carries away soil through surface runoff, that sweeps it into streams and lakes where it creates additional conservation problems. This is the water that serves our cities and our industries. This is the water that floods our valleys and our towns and cities. This is the water that provides all our water-based recreation, our fishing, boating, and swimming. This is the water that provides much of our power. This is the water that feeds our navigable streams.

Our growing awareness of the interlocking interdependence of land and water resources and of rural and urban interests in developing and protecting those resources has come about in several almost simultaneous phases. One of these is the greatly increasing nonagricultural use of land to provide space for our expanding population in which to live, to work, and to play. These new users of land almost immediately become involved with firsthand conservation responsibilities. The developer

Spreading subdivisions from coast to coast—like these in Santa Clara County, Calif.—bring land and water conservation needs home to city people.

The author is administrator, Soil Conservation Service, Washington, D. C.

A floodwater-retarding structure in Thompson Creek watershed in Tennessee's Henry SCD.

of a housing area, the builder of a factory, and proprietor of a golf course—in fact, every land user in city, suburb, or rural area—is and must be concerned with the soils and the water behavior at his particular site. More widespread understanding of the watershed approach is another reason for our improved attitude toward orderly development and management of our renewable natural resources.

Like every other country, the United States is physically a Nation of watersheds. Our longest rivers and their tributaries drain large areas. These areas are usually called river basins or drainage basins. Each major river basin is divided into several lesser watersheds, and each of these, in turn, is subdivided progressively into smaller and smaller watersheds down to those where surface waters first begin to collect.

We have come to realize that no two watersheds are exactly alike, that each one is an intricate, complete unit of Nature governed by natural principles that men can modify but never abolish or ignore. We have learned that action taken anywhere in a watershed that affects one resource will inevitably affect other resources. The chains of cause and effect in a watershed are numerous, long, and far-reaching. We know that efforts to use, conserve, and develop renewable natural resources without regard for watersheds and natural principles are certain to be costly and are likely to fail.

In addition, we have come to realize that our land and water resources can serve present and future needs of all interests only through application of the principle of multiple use. When storing water, for example, wherever feasible we should provide for all possible uses of an irreplaceable site instead of only a single use. Water supply, flood prevention, recreation, fish and wildlife, industrial development, irrigation—these are a few of the use combinations possible under the multipurpose principle.

Perhaps most important, in the development of our present enlightened attitude, is the conviction that the ideal arrangement for resource development is a cooperative one involving the community, the State, and, where necessary, the Federal Government. This three-way partnership has been successfully demonstrated for more than 25 years in soil conservation districts. The same principle is at the heart of the small watershed program, which was authorized by the Congress in 1954 as the Watershed Protection and Flood Prevention Act.

Today we are better prepared to tackle our renewable natural resource problems than at any time in our history. This is so because we have developed a better public understanding of how to do the job.

Watershed dam and lake in Old Tom Creek watershed project in Henderson County, Ill.

**Popular recreation area of watershed flood-prevention lake in Collin County, Tex.**

It is so because we have progressive State and Federal legislative tools and programs that provide for coordinated, long-range planning involving every segment and interest of our society, including several new authorities given the Department of Agriculture in the 1962 Food and Agriculture Act, that will be helpful in rural areas development and soil and water conservation work everywhere.

The small-watershed program, Public Law 566, was amended so it is now possible for the Soil Conservation Service to provide cost-sharing for water-based recreational developments in watershed projects. Funds can be advanced to acquire critical sites for water impoundments, and to provide municipal and industrial water supply.

Congress authorized changes in the Bankhead-Jones Farm Tenant Act which will permit locally sponsored Resource Conservation and Development Projects, when funds are provided, for carrying out a program of land conservation and use, under SCS leadership, in areas where acceleration of the present conservation activities plus the use of new authorities would provide additional economic opportunities to the people.

Congress similarly authorized a cropland conversion program that provides for long-range land-use adjustment programs, including conversion of presently unneeded or unsuitable croplands to other uses, such as for growing grass or trees. This program, with SCS technical help through soil conservation districts, will be headed by the Agricultural Stabilization and Conservation Service.

Congress provided for technical, cost-sharing, and credit assistance in establishing income-producing recreation enterprises on farm and ranch land.

The other new tool it provided is a Rural Renewal Program, under which projects can be developed locally that are aimed at relieving underemployment, strengthening family farming, and developing natural resources to assure permanence of the economic gains. The program will be handled by the Farmers Home Administration.

Most of us are land users in one way or another. When we all understand that each handful of soil, each raindrop, and each piece of land is intimately related one to another, when we are all armed with our present day conservation know-how—then indeed we will have the true and lasting answers to our natural resource problems.

## 10th Watershed Congress

"Understanding—Key To Progress" is the theme of the 10th National Watershed Congress to be held in Philadelphia, Pa., May 26-29.

The Congress is sponsored by 27 national organizations, including the National Association of Soil and Water Conservation Districts. It brings together top authorities and representatives of organizatons concerned with agricultural, community, and related water use and management from throughout the country.

Although it does not adopt formal resolutions, the Congress' participating organizations and other interests work at the local, State, and national levels year-round in behalf of water-conservation developments and policies projected in its annual discussions. These deliberations center on current water problems and opportunities that arise in soil conservation districts, watersheds, river basins, and elsewhere in the country.

Representatives of organizations having an important interest in public opinion on and attitudes toward water problems will take part in question-and-answer discussions, and a panel of speakers representing key interests and purposes in watershed and river basin development similarly will answer questions from the audience.

Initially scheduled session themes include those on resource and watershed understanding and avenues of resource development. Also on the program are talks and discussions on the Delaware River Basin compact and the Brandywine Valley program.

◆

Extension Horticulturist E. C. Wittmeyer of Ohio State University reports vegetable and potato growers often wait too long to apply irrigation water. He says that often a small application of water early in season will pay large dividends at harvest time.

# *Watershed Project Brings Many Community Rewards*

By Gordon S. Smith

**Leaders in project development (l. to r.): Town Manager Donald Chick; Ex. Sec. Edgar Ellingwood of Keene Regional Industrial Foundation; Pres. Edward Fairbanks of Regional Foundation and local developer; George Kingsbury, businessman and former SCD supervisor; Mayor Robert Mallet; and Ex. Sec. John Sias of Keene Chamber of Commerce.**

PLANNERS of New Hampshire's industrial city of Keene are finding that their recently finished Ash Swamp Brook watershed project is yielding dividends well beyond its basic flood prevention objectives.

Boosted tax revenue, better farming conditions, reclaimed land for home and industry, improved roads, wildlife enhancement, and mosquito control are a few of the community economic and other rewards stemming from the watershed project. It involves a wide valley section of Keene's western suburbs.

Melting glaciers, a few thousand years ago, plastered a mixture of clay, silt, sand, and gravel over granitic bedrock. The end product was good soil but one that was too wet for either profitable farming or city expansion in the 700-acre valley. Water from winter snows and summer rains swamped the potentially valuable valley several times a year. Stagnant water scalded farm crops, ruined pasture grass, swamped roads, and soaked home basements for days with each flood. The damages averaged $8,000 a year for the town.

Edward LaBonty, a Cheshire County Soil Conservation District cooperator, really started the watershed project idea on his farm near the edge of Keene when Soil Conservation Service technicians helped him plan a drainage improvement system he wanted for a 20-acre field. A few civic leaders saw the results and sought similar help on larger areas of the wet valley.

**Ash Swamp watershed project has improved wildlife habitat.**

With backing of the City Planning Board, the Chamber of Commerce, and the Keene Regional Industrial Foundation, the request grew into one of New England's first flood prevention projects under the Watershed Protection and Flood Prevention Act. The Act enabled the city, with local soil conservation district cosponsorship, to obtain Federal technical and cost-sharing help through the SCS.

A network of new channels was designed as the backbone of the 20-square-mile improvement plan. Seven miles of main channels and 3 miles of lateral ditches were needed to ease excess water out of the wet areas into nearby Ashuelot River. Upland conservation measures—planting trees and improved pasture grasses, individual farm drainage improvements, and building farm ponds—were an important part of the overall watershed protection plan. Landowners are continuing this work as their contribution to the project.

Arthur Whitcomb, a local contractor, moved nearly 140,000 cubic yards of earth to form the channels. Total cost for earthmoving and reseeding was $148,642. Local funds paid 35 percent of this total. Eighty-eight land easements, costing the city $10,000, were needed

**Evans H. Barrett, SCD cooperator and Keene councilman, worked on project plans in town and on farmland.**

The author is field information specialist, Soil Conservation Service, Upper Darby, Pa.

**More than 700 acres of improved land like this formerly was too wet for harvest of good hay crops.**

to clear the right-of-way before construction. In all, Keene paid $75,000 for the project and assumed future maintenance costs.

On the farming end of the watershed, the 1962 growing season pointed to future expectations from the improved water management and flood protection. As Evans H. Barrett of the Keene City Council, and a dairyman for 40 years, said:

"There was more snow than usual, but the new system made it possible for us to get out on the land 3 weeks earlier than ever before. Our corn production last summer was three times larger than normal. That means we don't have to spend money to buy feed now. But, even more important, our marginal land can be turned into prime pastures with this lower water table."

He figures about 1,000 acres in the watershed will be improved as farmers tie new farm systems into the watershed channels.

Similarly impressive results of the land improvements can be found in town. For example, Edward H. Fairbanks, a land developer, is building a million-dollar shopping center. He had started the project with a supermarket a few years ago, but tons of fill were needed to make even a small segment of the property usable then.

"We have been able to develop our land much sooner than originally intended, because of the watershed project," Fairbanks pointed out. "We have more land available for parking space now, which means larger retail floor space in the shopping center. Consequently, we will be paying taxes on improved land for commercial purposes that otherwise could not have been developed, because of the high water table. We consider the Ash Swamp project one of the best investments our city has made in a long time."

It is estimated that such tax increases will more than pay the local costs of the watershed project in less than 5 years. And they are only one of many economic improvements in the community.

One group of landowners, for example, is planning to improve land that will be used for a multi-unit housing development. A new bypass highway was built around Keene at a lower cost to the State, because it passed through land that had been improved by the project. New motels promptly were planned along the bypass to accommodate tourists and businessmen.

Local wildlife enthusiasts are equally happy with the project results. Hunters report an increase in pheasants and rabbits in the valley, and wildlife experts note that the lower water table has actually improved habitat and food for birds and small game, including seeding a wildlife food mixture along the new channel banks.

Benefits from Keene's watershed

**Supermarket in center of this area once too wet for development is being surrounded by 13-store shopping center from which taxes are expected to pay watershed project costs.**

project have just started. New industry, attracted by the progressive community, is expected to swell the city's 5,000-job, $18-million-a-year payroll. New schools, recreation centers, and other municipal improvements can be built with the increased tax receipts and the money saved from flood damage. In these and other respects, Keene has the promise of a brighter future with its economy on a safer footing.

# Ranch Watershed Job Pays Good Dividends

**By Robert Dellberg**

WATERSHED runoff can cause a sheep ranch a heap of trouble if something isn't done about it. And that's the fix the Guntly brothers near Ukiah, Calif., were in before they learned how to handle water.

A watershed rising above a 26-acre field on the ranch stirred up all kinds of trouble for John Foster Guntly and his brother, Charles. After heavy rains, water ran off the slope as though it were a tin roof. As the water flowed across the field it cut gullies up to 25 feet wide and 20 feet deep.

With such flooding and gullying happening just about every year, the field couldn't be irrigated efficiently and, without water, produced smaller and smaller grain crops under dry farming. That can mean trouble when you've got a lot of hungry sheep and lambs to feed. As Foster Guntly said: "We'd plant a sack of grain and harvest a sack."

Gullies split the fields into three separate lots. You couldn't go from one field to another without using an adjoining road.

The Mendocino County Soil Conservation District drew upon the Soil Conservation Service to help the brothers plan a series of five drop structures at the base of the watershed. The specifications called for 36-inch corrugated pipe to carry runoff safely to a grassed waterway.

**Big gully that no longer is!**

The plans also provided for conservation treatment of the watershed, including fencing and regulated grazing to give cover a chance to come back. Planting of woody vegetation on the hillside to prevent silting of the field below was another erosion stopper tied into the control plan.

The Guntlys carried out their plan with good results. Gullies were smoothed over and seeded, runoff was controlled, and an irrigation system was installed. The formerly low-producing field was planted to a standard pasture mixture, which had not been possible before these changes were made.

Those 26 acres are now one large field with nothing to hamper working it efficiently. The gullies are gone, and in their place are grass swales which make it easy for

**John Foster Guntly in reclaimed field. Grassed waterway at right carries runoff from hills.**

The author is woodland specialist, Soil Conservation Service, Ukiah, Calif.

equipment to pass over. Former District Director Guntly says: "This conservation job has changed 26 acres of gullied grainland nobody would want for $5,000 for the whole shebang into irrigated pasture worth every cent of $1,000 an acre."

Before they got the pasture, the brothers usually sold many of their lambs as feeders. Now they feed up to 350 at a time for about 6 weeks and sell them as fat lambs The lambs go in at about 65 pounds and come out at about 80, the gain representing one more dividend from the Guntlys' watershed conservation investment.

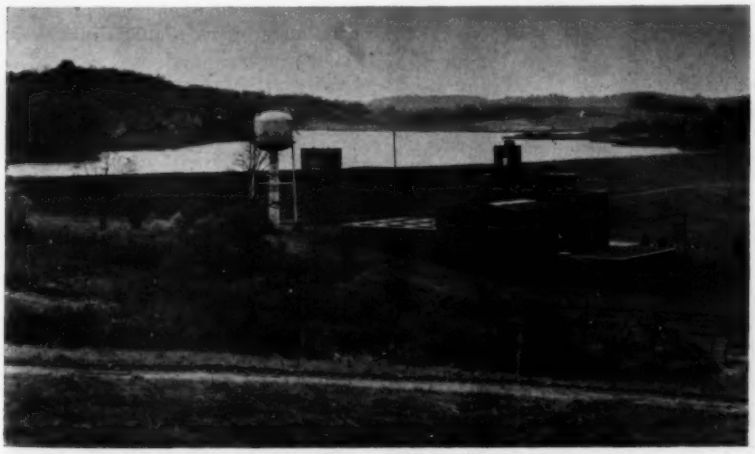
**Sprinkler irrigation ready to be started after construction, fertilization, and grass seeding were completed.**

# *Watershed Conservation Insures City Water Supply*

**By Willis J. Ridenour**

TO the saying that "rain falls on the just and unjust" could be added the equally realistic observation that water problems are sure to develop unless someone takes responsibility for what happens to the rain after it reaches the ground.

Winfield Mercer, superintendent of water for the city of Jackson, Ohio, has taken on that responsibility for 1,450 acres of tired farmland that sheds its water into Jackson's relatively new city reservoir, and he hopes to keep water problems under control for the sake of the land and his many water customers.



**Jackson water plant with 2 million-gallon daily capacity.**

City officials recall with pride when their municipal water plant and reservoir was dedicated. The $1.5 million project had been carefully planned by consulting engineers. They had designed the billion-gallon, 210-acre lake to handle all the water that runs off the Hammertown Lake watershed. The lake in turn had plenty of storage to run the filtration plant at its capacity of 2 million gallons a day —more than four times the need for Jackson's population of 8,000.

The author is soil conservationist, Soil Conservation Service, Jackson, Ohio.

"This is a far cry from the city's earlier water supply," Mercer pointed out in reviewing the project's development. "We got our water from a series of 53 shallow wells in a valley 3 miles southeast of the city. They ranged from a depth of 35 to 140 feet. However, the rock and sand formation of the ground couldn't provide enough water for current needs. We had no hope of meeting future demands for industrial and residential expansion. Drilling deeper wells wasn't practical, because of salt water conditions at lower levels."

But the city still had problems even with its new water set-up. The water feeding into the reservoir was muddy and polluted with soil from eroding crop fields. Mercer encouraged city officials to buy the entire watershed area so they could attack the problems that plagued them. This was a novel idea in Ohio, as cities with reservoirs seldom acquire land much beyond the shorelines.

The next step was to find qualified help for dealing with soil and water problems in the watershed. After talking with Clyde Heazlet, State farm forester, Mercer decided to ask the Jackson Soil and Water Conservation District to support a conservation program for the watershed and to furnish technical help.

The conservation job was started by liming and fertilizing the area near the reservoir shoreline and seeding it to bluegrass. Nearly 79,000 pine trees now give the old crop fields a green polkadot pattern. They were planted by a tree planter purchased by the city. The conservation plan calls for 75,000 more to be planted in the near future.

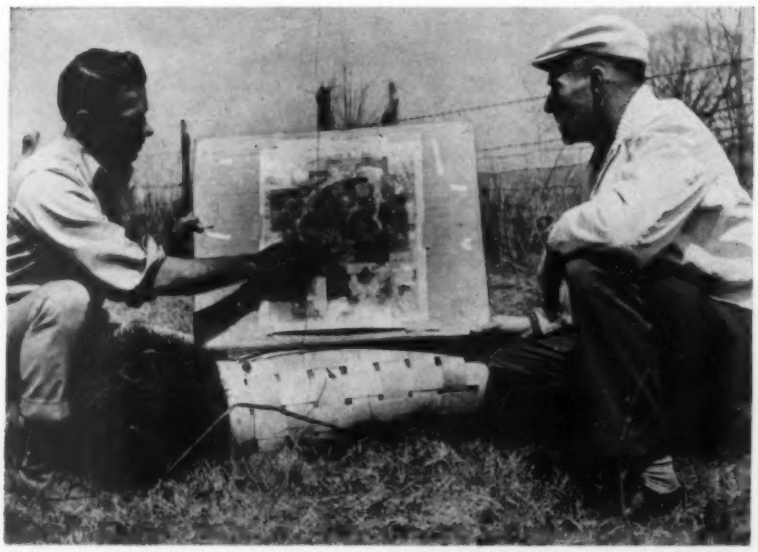
To put each acre to its best use, Mercer is also developing a recreation and wildlife program. An archery range has been laid out near the southeastern edge of the watershed. Roads have been built and areas cleared for picnicking and fishing. At the present time there are 15 picnic tables and cooking places, with plans to enlarge these facilities as needed.

The lake was first stocked with 40,000 bass supplied by the State Fish Hatchery. The demand for good fishing has increased at such a rapid rate that the City Water Service Commission has entered into an agreement with the State Division of Wildlife to manage the lake, and the Division has added pike to the stocked fish.

**Water Department employees planting pine on reservoir watershed.**

Many people say that as the small, family-sized farms are decreasing in southeastern Ohio, the wildlife population also is declining. Small fields of grain and clovers that used to supply food have disappeared. Using a soils map and technical assistance furnished by the Soil Conservation Service, Mercer plans to develop small-grain and meadow strips on the contour. This land treatment will encourage cottontail rabbits and bobwhite quail to live in the area.

"We're proud of our water supply and filtration plant, which is considered one of the best and most efficiently operated installations in the country," said Mercer. "The conservation practices we applied on its watershed area are good insurance that the reservoir will be long lived. It will give us lots of good quality water for years to come. And by developing the recreational potential, we are not only getting the fullest and best use for each acre of land, but likewise the fullest and best use for each gallon of water."



**Soil map which serves as guide for proper land use is discussed by Winfield Mercer (l.) and author.**

◆

The lifetime quota of water usage for the average person in the U. S. is 3,500,000 gallons.

# Utah Irrigators Lick Water Losses

By Don L. Braithwaite

CONCRETE was the answer to the long-standing flooding and water waste problems of Utah irrigation farmers in two canal companies north of Panguitch.

The farmers, under the McEwen Canal and the Barton, Tebbs, LeFevre Canal, divert water out of the Sevier River. The diversion on the McEwen Canal side formerly consisted of logs, rocks, car bodies, and manure. On the Barton, Tebbs, LeFevre side, the diversion was a dirt dam.

July and August are the months when thunderstorms occur in this area, and high water is common during this important cropping period. The old diversion had been known to wash out several times in one irrigation season. The time required to get the water back into the canals ranged from 1 day to a week. Crop yields were adversely affected nearly every year and some years were reduced severely.

The Barton, Tebbs, LeFevre Canal also had a bad moss problem which greatly inhibited the waterflow. Lowell Henrie, for example, whose farm is on the lower end of the canal, reported getting the benefit of only about one-half of his stream when the moss problem was at its peak.

In 1959, the two canal companies decided to build a new concrete diversion and put in ½ mile of concrete lining in the BTL Canal. The Soil Conservation Service, assisting the Upper Sevier Soil Conservation District, furnished technical services to prepare plans and specifications for the diversion dam. The Agricultural Stabilization and Conservation Service set up about $14,000 to help on the project, and the Utah Water and Power Board financed the local cost with an interest-free loan.

The irrigation dam was completed and water was turned into the canals in June 1961. The diversion has now withstood several large floods and many small ones.

Construction of new channel and diversion dam at site of old log dam.

"In the past," said James LeFevre, "when we had floods going down the river, we were out of water in both canals for as long as 2 weeks. Since this work was done, we haven't been out of water 1 hour. The moss has not interfered with the flow of our water as it always did before, and I have realized a much better stream under the BTL Canal. I feel that we made a good move when we constructed the diversion dam."

President Grant Houston of the BTL Canal observed:

"I am well pleased with the investment. The amount of water saved more than satisfies the costs."

The canals are diverted from each side of the diversion. By each outlet is a radial sluice gate. When the river is high, sluicing operations can be carried on without interfering with the stream size in either canal. In addition to the reduction in moss, the amount of silt accumulating in the canals and on the croplands is much less.

The diversion cost about $27,000, and the canal lining, with about 411 feet of drain, cost $9,197.

The diversion has a crest width of 60 feet and required 214 cubic yards of reinforced concrete.

Barton-Tebbs-LeFevre Canal after ditch was concrete lined.

The author is work unit conservationist, Soil Conservation Service, Panguitch, Utah.

# Georgia Towns Rea

By James Wh

Frank Green (l.), farmer, and Harold Smith, filling station operator, led successful drive to collect $22,500 for watershed project.

SEVERAL towns are among the urban and rural interests that already are reaping major benefits from Georgia's Little Tallapoosa River watershed in Carroll and Haralson counties.

Towns that once were resigned to regular water shortages now can count on an ample reserve of water for months to come. The new water supply is also attracting industries that are creating new jobs and will contribute heavily to the economy of the area. Carroll County has 75 industries, with employees ranging from 6 to 800 people.

Lakes spreading out in the watershed are being developed into recreational centers. The project will save an estimated $82,000 annually in flood damages, or 87 percent of the previous losses. Swamped-out land is being restored to pasture, vegetable, and other crops. Stream channels once clogged with silt are now clear. County roads that flooded with every heavy rain now carry increased traffic during rainy and dry seasons; and gullied roadsides have been graded and planted to grass, stopping erosion and beautifying the highways.

In March 1961, 17 bridges on Carroll County roads were heavily damaged by floods caused by heavy rains.

"It rained so much the blacktop floated off the roads," said J. C. Daniel, Carroll County Commissioner of Roads and Revenue. "The following December we had rains that were just as heavy, but, because of the dams that had been completed in the watershed, not a bridge was lost in the watershed area of the county."

There are six towns in or near the watershed: Carrollton, Villa Rica, Temple, Bowden, Bremen, and Mt. Zion.

Since the project was started in 1956, 11 flood-detention dams have been completed, 2 others are under construction, and the 14th and final structure is expected to be finished this year. The entire project is scheduled to be completed in 1965. It includes 32 miles of channel improvement, 714 acres of gully control, 40 miles of roadside erosion control, conservation on the farms, and forest fire prevention.

Sponsors of the project are the Carroll County government, the West Georgia Soil and Water Conservation District, and the towns of Carrollton, Temple, and Villa Rica. The Soil Conservation Service provides technical and cost-sharing assistance through the Watershed Protection and Flood Prevention Act.

Watershed reservoirs will supply 807 million gallons of water for Carrollton, Villa Rica, and Temple alone, with estimated combined annual benefits of $13,200. The three towns, which have a combined population of 14,000 people, and Carroll County are covered by an overall economic development plan as part of the U. S. Department of Agriculture's Rural Areas Development program.

Meanwhile, Bowden and Bremen have joined with Carrollton and the West Georgia district to petition for an expansion of the Little Tallapoosa project to include 139,-

Flood detention lake built in Little Tallapoosa River watershed to reduce silting in Lake Carroll, 2 miles downstream.

The author is work unit conservationist, Soil Conservation Service, Carrollton, Ga.

# Watershed Benefits

By James White, Jr.

000 acres in addition to the 62,516 acres now in the watershed. More water is needed to meet the needs of growing population, expanding industry, and farm progress.

A water-supply storage of more than 23 million gallons cost the town of Temple only $4,363. Villa Rica is spending $22,500 to have another reservoir enlarged to provide 148 million gallons of water storage. The town will pay for a pumping station and pipelines. Landowners gave the land.

The city of Carrollton built 176-acre Lake Carroll back in 1948, with technical help from SCS, as a municipal reserve water-supply reservoir; but siltation kept the reservoir's waters muddy and began filling the lake at an accelerated rate. A watershed flood-detention reservoir built above Lake Carroll and land treatment measures have reduced today's siltation rate in Lake Carroll by 50 percent.

The Little Tallapoosa plan was amended in 1962 to include 636 million gallons of water in the watershed's biggest structure, to enable Carrollton to meet its needs for rapid industrial growth. For this supply the city will bear an estimated $197,500 of the cost, and the estimated Federal cost for this reservoir's flood-prevention benefits is $167,000.

Hundreds of persons, both local and from distant points, have already been enjoying fishing and boating on the lakes of the watershed project. Many thousands more are expected to take advantage of the recreational facilities offered by these lakes every summer. The lakes are all open to the public. Visitors have only to contact the owners, none of whom charge more than a dollar a person a day.

Mayor Olin Johnson, explaining that Temple previously got its water from a creek but that when the creek ran low its supply was threatened, said of the town's new watershed lake:

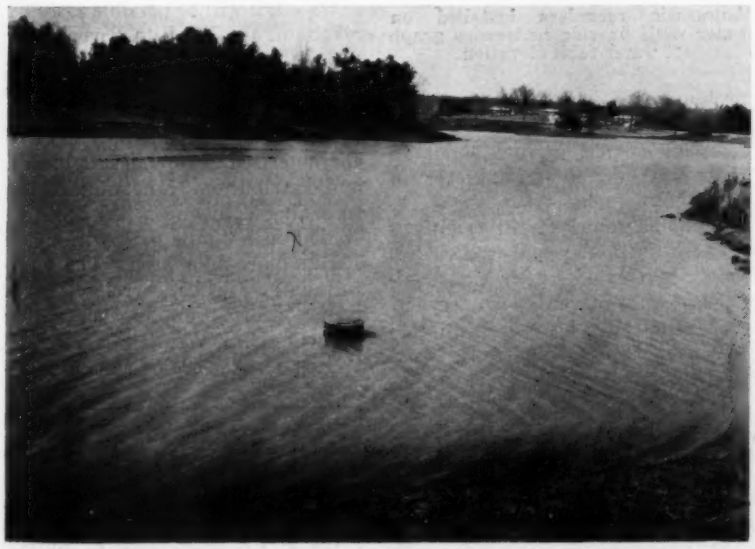
"We now have a 6 months' supply of water, even if it doesn't rain."

Similarly, Villa Rica obtained water from a small reservoir fed by a creek, and when the stream ran low there was no reserve. The watershed project included a flood-detention reservoir near Villa Rica. The town needed to raise $22,500 to pay the cost of increasing the reservoir to include water-supply storage, but its funds were tied up by litigation resulting from a gas explosion in 1957.

Only 4 days before the deadline, Frank Green, a cooperator with the soil conservation district and a member of the Little Tallapoosa River Watershed Association, and Harold Smith, operator of a service station, organized the Villa Rica Development Association and canvassed the town. Green, Smith, and five others put up $1,000 each. Other citizens responded, and in 4 days the $22,500 was raised.

As Commissioner Daniel puts it, the project has brought individuals and groups closer together in the watershed—"folks in the towns and rural areas, businessmen and civic leaders, representatives of county and municipal governments. We are all benefiting from the project—it's a vital link in the chain of progress in the area."

Channel improvement like this on Little Tallapoosa River totals 32 miles in watershed project.



This flood-detention lake provides 23 million-gallon water supply for town of Temple.

# Study Downstream Effects of Upstream Watershed Improvements

By M. A. Hartman and W. O. Ree

THE Washita River in central Oklahoma has a long record of frequent and damaging floods. Losses in this agriculturally important valley were so great, in fact, that the Washita was one of the 11 major river watersheds for which flood-prevention operations were authorized by the Flood Control Act of 1944.

Since 1946, the local landowners, soil conservation districts, and the Soil Conservation Service have been vigorously applying a planned program of land treatments and structural measures for watershed protection and flood prevention in the tributaries of the Washita. This comprehensive effort is still under way.

The major effects of the program on the tributaries are reasonably well understood, but not so well understood are the effects that treatment on the tributaries will have on the mainstem flows and channels. When Congress appropriated funds in 1961 to establish watershed research in the Southern Plains, it accordingly seemed only natural to choose these mainstem effects as its central objective. An untreated segment of the Washita watershed between Anadarko and Alex, Okla., was chosen for this needed study.

Specifically, the main purposes of this research project are to determine how upstream conservation and water-control measures affect: (1) Mainstem floods, (2) total annual flow of the river, (3) sediment flow, and (4) the stability of the river channel. Effects on reservoir silting and ground-water levels will also be investigated.

The Anadarko-Alex study reach includes 78 river miles of the Washita and the 1,128 square miles of watershed area directly tributary to it. The study area lies principally within the Reddish Prairies problem area in soil conservation, but contains some Cross Timbers. Alluvial soils constitute about 18 percent of the total land area in the study reach.

**Automatic recorders installed on water wells provide continuous graph of water-table elevation.**

Although none of the tributary watersheds in the study reach has yet been treated under the flood-prevention program, some conservation practices have been applied to some of these lands. It is expected that watershed treatment, for which planning already has been authorized or completed on some tributaries, will extend into the area within the near future, thus providing an opportunity to observe conditions both before and after treatment.

A basic hydrologic problem is to account for all precipitation that falls on the study area. A complicating factor is the time required for a raindrop to travel from the point it strikes the soil to the point where it may again be observed. This travel time depends on the distance moved, the route taken (which might be by surface or subsurface or a combination), and on the forces moving the raindrop on its way and those resisting its movement. Only when the role of each channel, reservoir, or aquifer providing the pathway for the raindrop is known will the effect of land treatment and water storage on the flow regime of the river be completely understood.

The data will lead to a disclosure of the laws of hydraulics determining the movement of water through channels and aquifers of the watershed. When this understanding is achieved, it will be possible to apply results of the Washita River study to predict the influence of upstream flood-control measures in other river basins.

The precipitation supply must be characterized by amounts, rates, and distribution. A network of 175 recording rain gages has been installed on a 3-mile grid within the 1,128-square-mile area. The rainfall data will be correlated with radar information, in cooperation with the U. S. Weather Bureau activities on meteorological radar re-

**No. 70**

**This is the seventieth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.**

The authors are, respectively, research hydraulic engineer, Chickasha, Okla., and investigations leader, Stillwater, Okla., both of the Agricultural Research Service.

**This Washita River area is being surveyed periodically to determine rate of bank erosion.**

search.

Small watersheds will be selected within the study area for more intensive investigation. These field-size units, representing a sampling of the soil associations and land-use conditions, will provide information on the hydrologic performance of the significant runoff source areas in the uplands and on the flood plains of the Anadarko-Alex reach. These data will provide a basis for interpreting the significance of changes in land-use and management practices upon rainfall-runoff relationships. They also will be an important link in establishing the connection between the hydrology of upstream and downstream areas.

Streamflow in the study reach will be measured at 5 stations on the main river, including both the entrance to and exit from the study reach. The 10 tributaries entering the river within this length will also be gaged. Surface flows and subsurface flows in the valley alluviums and changes in soil moisture and ground-water storage will be measured to determine total water yield.

Development of a better knowledge of the relationship of mainstem sediment yields to climatic factors and the use and treatment of watershed lands is another of the major interests of this research program. The processes of reservoir silting also will be investigated. One or more floodwater-retarding structures will be selected for detailed studies of trap-efficiency, distribution and density of deposited sediment, delta development, and degradation or other channel adjustments downstream from the reservoir.

Observation and study of changes in stability or equilibrium of the Washita River channel in association with application of the watershed treatment measures is another primary area of interest. In this aspect of the study, it will be necessary to differentiate between: (1) Natural processes already under way or likely to develop; (2) any induced changes related to regulated flows released from the large water storage reservoirs upstream; and (3) any induced changes related to changed flow regime attributable to the watershed treatment program. Reconstruction of this history of the channel will help to make the differentiation.

The extent of installation of land-treatment measures and water-control structures in the study area is being charted and a complete land-use inventory maintained.

The effect of land use and structures development on the hydrology, sedimentology, and channel stability of the river will be determined by charting trends and defining relationships. A detailed study of the flow regime for an earlier 10-year period will provide a base for comparison.

**Washita Flood Prevention Council representatives study one of 175 recording rain gages.**

# Irrigated Land Leveling Saves Water and Labor

By Wayne D. Wavrin

CONSISTENT savings in irrigation water and labor and better crops are reported by farmers who have leveled their land in the Lower Yellowstone Irrigation Project in North Dakota.

Land leveling has increased 280 percent on the more than 50-year-old project in 5 years. More and more farmers have found that fields which were considered good enough a few years ago are water wasters and labor robbers. Farmers along the Missouri, Heart, Cannonball, and other rivers also are leveling their land for more efficient use of their irrigation water, as are those using underground sources.

Siphon tubes give maximum efficiency in water use on Henry Bauman farm in Lower Yellowstone SCD.

An informal survey of 15 Lower Yellowstone irrigators showed that for 12 farmers growing sugar beets and beans, the water saving was at least 300 acre-feet on 307 acres during a single growing season. After their fields were leveled, the average amount of water applied in each irrigation dropped from 9 to 4 inches. There was no more drowning in the low places or lack of moisture on the high spots, resulting in more uniform yields and better quality crops.

Labor requirements, meanwhile, dropped from 8 to less than 2 hours an acre for each irrigation. This saving alone went far toward paying for the land-leveling costs, which averaged $54 an acre.

Production efficiency also was better for alfalfa and small grains. Where leveling and border dike systems replaced conventional ditch methods, the water and labor savings were appreciable. Before leveling, an average of 8 inches of water was applied in each irrigation—after leveling only about 4 inches. The actual labor time dropped from 3 hours to ½ hour to the acre. Irrigation runs were longer; there was less ditch to use and maintain; distribution of water was better; and better yields resulted.

"I use only half the water now and got a 40 percent increase in beet yield," Robert Flynn, a district cooperator, reported. "I've got 2 acres more land, too, because good land leveling has eliminated most field ditches."

Land leveling was needed for proper drainage and management of irrigation water on this field in same area.

The author is State conservation engineer, Soil Conservation Service, Bismarck, N. Dak.

"The most significant changes after leveling were a reduction in man-hours needed to irrigate and a 40 percent increase in production," Andy Cayko said. "Under the new arrangement, I can do the cultivating, haying, and other seasonal tasks and still manage the water by myself. With the use of siphon tubes and better designed head ditches, I can change sets in 15 to 20 minutes. I can irrigate 15 to 20 acres in a day and not spend more than 2 to 2½ hours doing it."

Such experiences are representative among cooperators of the Lower Yellowstone district. The district supervisors and assisting Soil Conservation Service technicians for their part realize the need and importance of improved water application, and have geared their operations to it.

The farmers are unanimous in recommending that all land leveling must be preceded by an engineering survey on which the cuts and fills are based. Proper water management, with precise land grading, is needed to provide high irrigation efficiencies. Most of them also agree that some adjustments in size of irrigation streams, time of irrigation, and length of runs will add even more to the saving of labor and water.

# Waterfowl Marsh Developments *Catch on in Connecticut*

By Edwin A. Swenson, Jr.

THE idea of marshland development for waterfowl has become contagious in Litchfield County in Connecticut.

This area presents an inviting mixture of dairy farms and country residences situated in a rolling, glaciated countryside. More than 60 percent of the county is in second-growth timber, much of it on poorly drained soils. Much of the seasonally wet acreage once was kept open by mowing and mid-season grazing; but with changing land use and farm mechanization, these wet fields reverted to dense stands of low quality hardwoods.

At about the turn of the century, when farmland was being abandoned, the far-sighted White family began buying up land near 750-acre Bantam Lake. Extensive natural marshes and swamps were included within the more than 4,000 acres eventually acquired. Today, the White Memorial Foundation manages these lands as a trust to keep them in a natural state. A program of woodland management, nature education, outdoor recreation, and wildlife management is administered by a trained staff.

The White Foundation early recognized the problems of maintaining the wetlands as a productive habitat for waterfowl. The Connecticut State Board of Fisheries and Game helped it develop a plan to keep the reverting marsh and swampland suitable for waterfowl. Basically the plan is simple: prevent the invasion of hardwood trees and produce quality annual foods by managing water levels. Through the Litchfield County Soil Conservation District, the Soil Conservation Service provided engineering help in designing and installing needed water-control structures.

The success of the White Memorial Foundation program soon was evident to the nearby landowners.

Millett planted after water in Manfred Young wildlife marsh was drawn down in the spring.

The author is work unit conservationist, Soil Conservation Service, Newton, Conn.

Japanese millet on Sam Swendsen farm.

Bird watching in marsh habitat provides recreation for many people.

Their reward may be a view of Canada geese like these protecting nest.

Flocks of Canada geese and various kinds of ducks became a local sightseeing attraction. Waterfowl also began to be seen on ponds and swamps around the Bantam Lake area.

Meanwhile, a conservation program on the nearby dairy farm of District Supervisor Sam Swendsen included plans for developing a waterfowl marsh on a poorly drained portion of wooded pasture. The State Board of Fisheries and Game paid construction costs. The Swendsen marsh floods about 8 acres. Water levels are manipulated to allow seeding Japanese millet on exposed mud flats. The first year of flooding, during the fall of 1961, as many as 400 ducks used the marsh at one time; and the next spring the marsh provided waterfowl nesting sites.

Local interest really picked up after hunters and birdwatchers had seen the results on Swendsen's marsh. During 1962, the soil conservation district received many inquiries about building wildlife marshes, and the Litchfield County ACP approved cost-sharing for them.

The neighboring Lizauskas brothers often had hunted on Swendsen's land for released pheasant, but after a taste of duck hunting on his new marsh, they decided there must be a spot on their own farm for a wildlife marsh. With Soil Conservation Service technical help, they located a suitable site, built a water-control structure, and developed a 2-acre marsh flooding back into a red maple swamp.

Miss Natalie Van Vleck, who raises sheep for breeding and exhibition, was another who watched the Swendsen marsh development with interest. A conservation plan worked out on her farm included converting a wooded swamp into an 18-acre wildlife marsh, by installing an earthen dam, with the State Board of Fisheries and Game agreeing to pay 20 percent of costs. Plans are to keep the marsh flooded for 2 years, until the trees are killed, and then to begin annual seedings of millet.

The upper end of the Van Vleck marsh borders on lands of the Regina Laudis Monastery, whose working nuns operate a truck crop and fruit farm. When they heard of the waterfowl developments next door, they also became interested in cooperating, by chemically killing the trees that border the marsh in a strip 80 feet back from the water's edge, and thus releasing the native sedges and low shrubs to provide nesting cover.

Just north of Swendsen's place, Rear Admiral Charles McVay, retired, owns a small Hereford beef farm. After visiting with Swendsen, he developed two waterfowl marshes, including a permanent pool for fishing on one site.

Wildlife biologists say wetland developments for waterfowl become most valuable when they form colonies of many sites around a large natural wetland. The success of the wildlife marshes on the White Memorial Foundation lands and the efforts of conservation agencies working with landowners have led to the start of just such a successful complex of waterfowl developments on private lands in Litchfield County.

Topics keyed to techniques of today's space age make up discussion fare for western water experts at the 31st annual meeting of the Western Snow Conference at Yosemite National Park April 17-19. The topics include the airborne radio-metric snow survey system, water runoff shifts and cloud seeding, instruments and telemetering, soil moisture and snowpack evaporation, highway snow removal, avalanche control, and human aptitudes in snow science.

# Paper Mulch Helps Grass Grow on Dams

By William L. Smith

A NEW paper mulch method of seeding grass on the slopes of floodwater dams is getting its third year's tryout in Texas small-watershed projects.

Soil Conservation Service technicians working with local watershed organizations still have not decided on general extension of this seeding technique and plan to sod or seed most dams in 1963 by conventional methods; but 1961 and 1962 results from the paper mulch were promising enough to warrant the Service's buying a special seeder in 1962 and trying the new method on an operational basis. Three trial seedings in the Trinity and Upper Washita watersheds showed "excellent" results at the end of the 1961 growing season.

In 1962, nine sites in the Trinity were seeded to common bermudagrass with the mulch, under irrigation, with "good to excellent" results; and two sites in the Upper Washita were seeded to native grasses without irrigation, likewise with good results.

The planned 1963 paper mulch seedings total 250 acres (including 20 acres of "critical areas") in the Upper Washita, Middle Colorado, and Trinity watersheds.

The problem of getting a protective cover on new floodwater-retarding dams involves establishing thick and tight-rooted grass as quickly as possible. Grass cover gives earthfills and excavations the kind of protection nothing else can.

In trying the new mulch method, the SCS is working with one of the Nation's largest manufacturers of paper products, which developed the process. Tests also are being made in some small-watershed projects in the Eastern States.

The method makes use of a specially treated cellulose fiber processed from wood. The fiber, in a watery mixture with grass seed and fertilizer in suspension, is sprayed on the sloping earth, so the grass will germinate and root in the soil underneath the film of paper mulch. The mixture, with green dye, usually is sprayed at the rate of 1,000 pounds to the acre, dry weight. The green color makes it easier for the operator to cover the surface evenly, much as one would paint a wall with spray equipment. Starch and resins are added, at the rate of 1 gallon to 400, to increase the erosion resistance of the cellulose and help to hold the seed in place.

The spraying equipment has a built-in agitation system and thoroughly mixes a slurry containing up to 40 pounds of fiber and 70 pounds of fertilizer for each 100 gallons of water in a 1,000-gallon tank. Hydraulic nozzles give even distribution up to 150 feet. One acre an hour can be mulched and seeded, meaning that more seeding can be done during the time of year which offers the best results, depending on how fast and uniformly the grass cover develops.

Check seedings in the Chambers Creek subwatershed of the Trinity near Corsicana showed that the cost of the paper-mulch planting was no more than that for sprig sodding.

The author is agronomist, Soil Conservation Service, Denton, Tex.

April 4—Paper mulch being sprayed on watershed dam.

July 13—Excellent stand of irrigated bermudagrass was obtained.

July 13—Only a sparse stand resulted on area seeded without paper mulch.

# SNOW WATER

By R. A. Work

APRIL is a key month for irrigators and other water users in the West. This is the month when snow surveyors and other authorities on water supply put their heads together and come up with forecasts of the amounts of water that will be available in this vast area's streams and reservoirs for the ensuing water-using season.

The west-wide April-September snow runoff forecast is compiled by the Soil Conservation Service, which coordinates the information gathered by its own snow surveyors and those from other cooperating agencies, and published as of April 1. This widely distributed summarization of prospective streamflow for that period, and of reservoir storage on the first of April, is in addition to detailed monthly (January-May) snow survey reports issued for individual States.

Although the April report represents the key forecast in each snow survey area, it is not always the last word. Heavy snowfall after April 1 well may improve short water prospects in a watershed, or even make it necessary to revise a "normal" water-supply forecast to one warning of prospective excessive runoff and consequent flood danger. By the same token, unpredictable rainfall not only may provide an early-season bonus in water supply but may bring flooding hazards by hastening the spring snowmelt, saturating watershed soils, and adding to the volume of water that streams are called upon to carry.

Ordinarily, however, the season's forthcoming water-supply pattern is more or less firmly set by April 1, because the major part of the snowpack has been laid down in major storms which customarily occur during the winter months of December through March. In fact, the water outlook reflected in earlier snow surveys, especially those in early March, not infrequently coincide generally with the final spring forecasts. Some water users, such as sugar beet companies that have to plan planting acreages months in advance, find even the February or January reports on the water content of the mountain snowpack at that time to be of substantial guidance in setting up contracts with growers.

Together, the monthly snow survey figures more often than not spell out the season's water trend; that is, of short, normal, or above-normal water supply. This year, for example, the January and February snow surveys pointed generally to a below normal streamflow outlook, offset in part by normal or better reservoir storage, except in Arizona, where the water outlook was good. By March 1, the situation was improved by 10 percent along the continental divide from Denver to northern Montana, but declined 10 percent in Utah, Nevada, and southern Oregon, with other areas little changed.

Farmers in irrigation projects and soil conservation districts accordingly began in advance of the April forecast to plan recommended cropping adjustments. Included are the planting of more early-season crops, to take advantage of early runoff, and limiting their acreages of heavy water using, late-season crops.

The water forecasts have become increasingly dependable—to within 5 percent of complete accuracy in some instances—since the general snow survey program with Federal assistance started in 1936

Snow above the Snake River (center) along the Grand Teton range north of Jackson, Wyo.

The author is head, water supply forecasting unit, Soil Conservation Service, Portland, Oreg.

to replace previously isolated surveys in a few States. Each year's added snow water measurements at any of the approximately 1,500 snow survey courses increases the reliability of the course's measurement average and predictable variations.

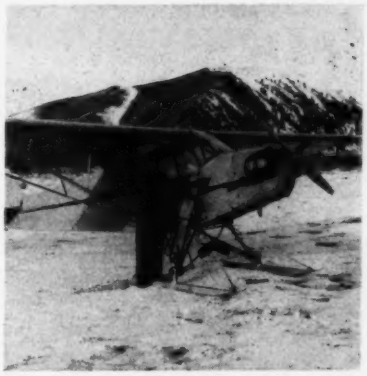
At the same time, however, the SCS is continuing special efforts to improve further the accuracy of the snow measurements and the speed with which they can be made available to water users. Multiple-purpose reservoir operators, for example, depend heavily upon the water-inflow forecasts. They need to know at the earliest possible date whether to hold all the water available for irrigation, hydro-electric power, municipal and industrial water supply, or other use, or whether to lower the reservoir level and make room to hold back excess water for flood prevention.

For years, getting this information depended solely upon teams of snow surveyors' traveling on snowshoes or skiis to oftentimes isolated marked courses established in major storm paths. Later, short-wave radio was drawn upon to speed the relaying of the field data to compilaton headquarters; and over-the snow machines were introduced to carry surveyors to distant courses. Within the last decade or so, aircraft has been used to reach some more inaccessible locations, and for checking from the air midwinter snow depths measured on marked poles.

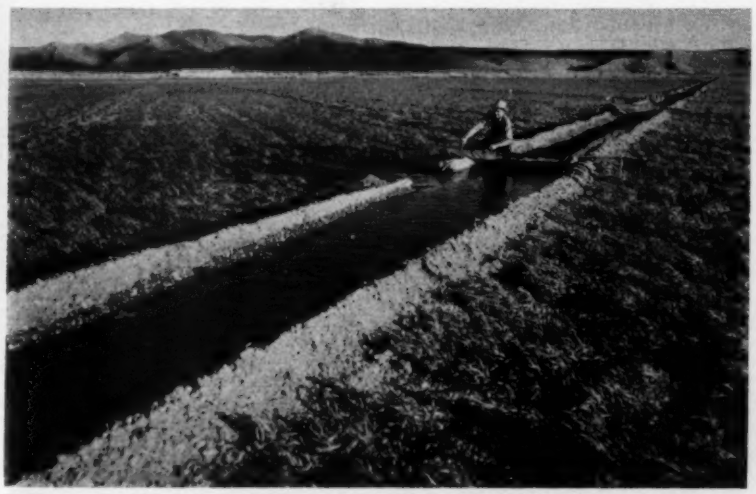
The Soil Conservation Service now is using automatic data processing equipment as a means of handling data and improving the accuracy of the forecasts. Further improvements are expected as more extensive data are obtained with automatic measuring and transmitting equipment.

To this end, attempts are being made to develop such devices that will measure snow water content, soil moisture, and perhaps other hydrologic data and transmit the data to a central location or to aircraft, probably by adaptation of currently available radio equipment. The problem of measurement of snow water content in such a way that data may be telemetered from isolated locations over a period of several months without attendance for the installation remains to be solved. Electronic devices have shown promise in trials.

This automatic equipment would make it practicable to put in snow courses in isolated areas where it is not now practicable to send men on foot, in oversnow machines, or even in helicopters, though many times they are the most desirable locations. In years of potential flooding, this automatic equipment would make possible a daily inventory of snow in the watershed.



**Space-age electronic devices hold promise of supplanting even aircraft and personal measurements on snow courses by sending the data in automatically.**



**Snow water brings life to irrigated lands of the West like these near Gannett, Idaho, in Blaine SCD.**

Growing uses of water and competition for economically available supplies, in the West as elsewhere, are making it increasingly important—and urgent—to have available the best possible information at all times. Those concerned range from farmers and ranchers to municipalities, from industries to flood-control and forest fire-prevention authorities, and from inland navigation interests to the growing numbers of people who use the lakes and streams and snow-covered mountain slopes for recreation. Today's improved snow water forecasts serve them all.

# Irrigators' Management

## Key To Water Saving

By Tyler H. Quackenbush

WATER conservation is a subject of growing concern to communities everywhere alarmed by the rapidly growing demands on our water resources. Government and industry alike are studying ways of making water go further by making a given amount do more jobs or by reducing waste.

For example, the average per-capita use of municipal water increased from 95 gallons a day in 1900 to 148 gallons in 1955. Power, navigation, pollution control, and recreation are expanding and demanding their share of our limited water supplies.

One of the biggest opportunities for water savings is in a still increasing irrigation agriculture, where most of the supply already is used—85 percent of all the water consumed in the United States in 1960. In some western watersheds, as much as 90 percent of the streamflow is used for irrigation; and in the East irrigation rapidly is becoming an accepted practice in modern agriculture. Nationwide, irrigated acreage expanded by 7.3 million acres from 1949 to 1959 to 33 million acres.

This expansion of irrigation can continue only as long as there is an adequate supply of water for all users. Increasing the level of efficiency in its use offers one of the most promising opportunities for meeting the growing demand for water in the future.

Many people believe that pipelines, lined ditches, land leveling, and sprinklers are the final answer to higher irrigation efficiencies. Although they all play a part, the real answer to good efficiencies lies in the ability of the farmer to use properly the tools at his disposal, whether it be a land-leveling job or a sprinkler system. Good irrigation water management, irrigating at the right time, putting on the right amount, and putting it on at a rate the soil will absorb without excessive runoff or erosion are essential to get the results we want. To illustrate:

In 1950, the Soil Conservation Service started an organized program of irrigation water management in the Redlands-Highland Soil Conservation District in California. As no major changes were needed in the sprinkler irrigation equipment, the conservation program was aimed at showing the irrigators how to use their sprinklers, when to irrigate, and how much water to apply at each irrigation, based on soil analyses, water needs of the crop plants, and other factors.

On 513 farms of 10,072 irrigated acres, 161 acres had been underirrigated, 1,844 efficiently irrigated, and 8,067 overirrigated. As a result of changes made in the 10-year period 1950-59, the farmers used 50,220 acre-feet less water than they would have used under previous methods—and saved $1 million in water and labor costs!

In 1960, with 202 farms and 4,720 acres under improved water management, 12,880 acre-feet of water was saved, at an average cost of $17 an acre-foot, or an indicated saving of $219,000 in 1 year. But even more important than the monetary savings is the fact that pumping from the basin was reduced, thus insuring a more dependable supply of water during the dry season. Yield, size, and quality of fruit were as good or better after the reduction in water use, and there was less root rot and less

Sprinkler irrigation, properly operated, is economical of water.

The author is irrigation engineer, Engineering Division, Soil Conservation Service, Washington, D. C.

Siphons give irrigator good control over amount of water applied to his crops.

Checking how fast soil absorbs water (intake rate), which determines most efficient irrigation methods to use.

leaching of fertilizer from the soil.

Good irrigation water management is a concept or philosophy that depends upon the desire of the individual irrigator to practice it. Often demonstrated reasons for him to practice such good water management include the fact that better management of the water on the farm usually will (1) reduce the amount of water required, (2) increase yields and improve quality, and (3) reduce labor requirements.

Likewise essential to improving irrigation water management is the irrigator's access to information concerning such seemingly simple items as "when to irrigate and how much water to apply at each irrigation." The solution to these problems requires a knowledge of plants' rooting habits, the water-holding capacity of the soil, and the rate at which the plants use water.

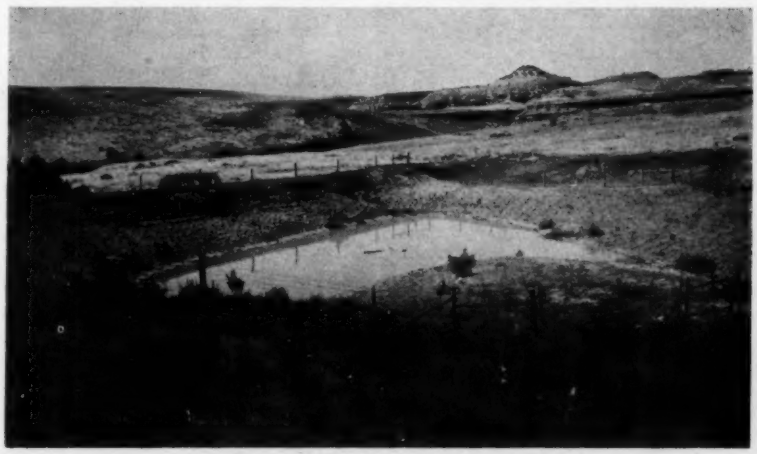
A good irrigator must be a combination soil scientist, agronomist, and engineer. Efficient water management is not a simple job; it takes effort and "know-how." Sprinkler systems, land-leveling jobs, lined ditches, and pipelines are all among modern tools available for getting good irrigation efficiencies; but without the proper handling of the water on the land itself, a completely effective job cannot be done.

# Bentonite Pond Lining Solves Water Problem

**By Jack Wiese**

RANCHER Adam Lungren of Washakie County in Wyoming has found bentonite lining to be a satisfactory answer to the problem of leaky and undependable stockwater ponds and is benefiting by better grazing distribution and grass improvement as a result.

A pond on his Upper Nowood ranch 25 miles south of Tensleep was the only source of water for one large pasture. It would fill every spring, but by early summer, when water is badly needed, the



Lungren's bentonite-sealed stockwater pond.

The author is work unit conservationst, Soil Conservation Service, Tensleep, Wyo.

PUBLIC LIBRARY
APR 26 1963
DETROIT

GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS
WASHINGTON 25, D. C.

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE TO AVOID
PAYMENT OF POSTAGE, $300
(GPO)

If your address changes, please notify us of your complete new address, including zone or RFD number, and include old address with our code number as shown above.

pond would be bone dry. Because this pasture thus could be grazed only in early spring when water was available, good grazing management was almost impossible.

Soil Conservation Service technicians working with the Nowood Soil and Water Conservation District suggested enlarging the old dam and lining the pond with bentonite to prevent seepage. The "mixed blanket" process was used to apply refined bentonite evenly at a rate of 2 pounds to the square foot over the 12,500 square feet of reservoir area, disking to mix the sealing material with the soil, and then packing it.

The pond area was fenced to keep livestock from breaking the seal. A 1-inch diameter pipe was installed through the dam to a home-built tank equipped with an automatic float valve that maintains a constant water level, and with a plank float to prevent trash or silt from clogging the pipe.

The project cost approximately $750, part of which was financed through the ACP cost-sharing program.

The pond filled to capacity from spring runoff in both 1961 and 1962, and still contained a good supply of clear water in late September. The new source of dependable water has made it possible for Lungren to utilize formerly ungrazed areas and is contributing to proper grazing over the entire ranch. As a result, many areas already are showing improvement in range condition; and he has revised his ranch conservation plan to include three more lined stock ponds.

Lungren's water-conservation improvements also are a step toward stabilizing the watershed of the Nowood River. Floods in the spring of 1962 were so severe that this watershed was classified as an emergency flood area by the Agricultural Stabilization and Conservation Service, and was allocated some $30,000 in extra funds for conservation practices to offset flood damages.

**ALLUVIAL EMPIRE. Vol. 1. By Robert W. Harrison, Delta Fund in cooperation with Economic Research Service, USDA. Pioneer Press. Little Rock, Ark. 1961. $8.50.**

This 344-page volume deals with man's battle to reclaim and protect the 30-odd-million acres lying in the Mississippi Delta—a battle going on for some 200 years.

A listing of the chapter headings gives a preview of the comprehensive scope and detail of this volume. They range from Chapter I—The Lower Mississippi River to Chapter VI—Land Forming for Drainage and Irrigation in the Mississippi Alluvial Valley.

What is not revealed in the chapter headings is the thoroughness with which the author unravels the history, magnitude, and persistence of man's efforts to conquer or, more correctly, to control, the Lower Mississippi. The author's description of the valley brings into sharp focus the relentlessness of the forces of Nature in shaping the river's—and man's—destiny. History, legal and organizational problems, and maneuvering over the centuries are brought alive and clearly reveal the difficulties involved in handling so vast an area by isolated and uncoordinated efforts.

An important aspect of this book is its attention to detail. Virtually all of the data come from original sources.

This is a must book for every land economist, legislator, agriculturalist, and flood control or drainage engineer.

The author brings into this work not only good and vivid writing, but expert knowledge of economics and geology, and a familarity and feeling for the Alluvial Empire and its history that earmarks this as an outstanding contribution to the literature of man's efforts to work with Nature.

—FRED H. LARSON